LIQUI-MOVER® PUMP

LMHT-500 SERIES

HANDBOOK

JOHNSON
Making the Best Solutions Possible

LMHT-500 Handbook rev. 09.04

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What is a Liqui-Mover® Pump?

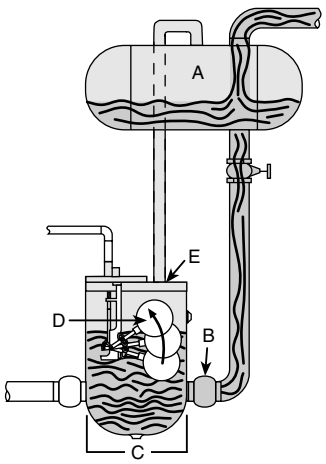
A Liqui-Mover pump is a positive displacement pressure powered pump with a minimum of moving parts. The pumping action is accomplished using a positive pressure to push the liquid from the pump tank into the return line. The Liqui-Mover pump can handle high temperature and high pressure condensate without difficulty.

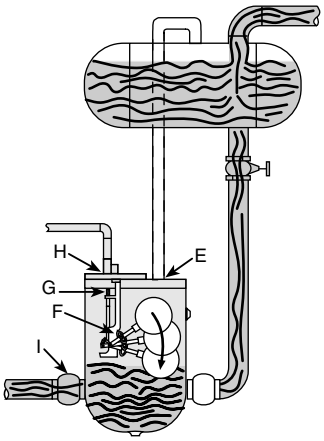
The float actuated Liqui-Mover pumps are available in 3 basic models. They are available in many configurations, from individual components that are field assembled to complete packaged systems ready for connection to field piping. A basic Liqui-Mover pump consists of a receiver/reservoir, pump tank, inlet and outlet check valves, snap acting float operated level control, and various other fittings.

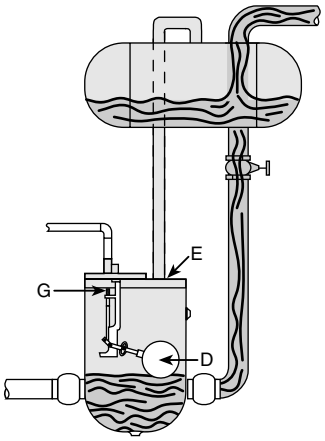
How a Liqui-Mover Pump Works

In describing “How a Liqui-Mover Pump Works”, it is best to view it as three distinct stages. These stages are described below:

Float Activated Level Control







STAGE ONE:

In the fill cycle, fluid flows from the receiving chamber (A) through the inlet check valve (B) into the pumping chamber (C), and raises the float (D). The vent port (E) is open to equalize pressure between the receiving chamber and pumping chamber.

STAGE TWO:

When the float reaches its highest level, a spring assembly (F) activates the linkage (G), which closes the vent port (E) and opens the motive pressure port (H). When the pressure in the pumping chamber exceeds discharge line pressure, the discharge check valve (I) opens, and the discharge cycle begins. As the fluid level goes down, so does the float. During this cycle, incoming fluid is stored in the receiving chamber.

STAGE THREE:

Once the float (D) reaches its lowest position, the linkage (G) closes the motive pressure port and opens the vent port (E) so the two chambers can equalize in pressure to start the cycle again.

Installation

Receipt of Equipment

The float assembly has been adjusted and tested at the factory. Additional items such as the inlet baffle (if supplied), check valves, level gauge glass, cycle counter, and insulation jacket will be packaged separately in a carton shipped with the unit.

Setting the Unit

On LOOO models, the pump tank may be anchored to the floor using the holes in the mounting feet.

On LROO models, you will also need to install a Johnson supplied receiver. The receiver is held in saddles with 'U' bolts supported by (4) pipes on floor flanges. The floor flanges have mounting holes for attachment to the floor.

On LRSM models, the entire skid should be supported. Mounting holes may be drilled through the skid for attachment to the floor.

All tanks should be installed level.

Piping

On LROO and LRSM models, the Johnson supplied receiver will normally have (3) top connections for: condensate inlet, atmospheric vent, and pressure gauge. For 'closed systems' (no atmospheric vent), an air eliminator and safety relief valve will need to be installed. On LOOO models, the condensate is piped directly to the inlet check valve from an existing receiver or pipe accumulator.

Refer to the Johnson assembly drawing that accompanies this product for typical piping diagrams. The inlet baffle (if supplied) must be installed into the pump tank prior to installing the inlet check valve.

The motive gas (normally steam or compressed air) is piped to the float assembly (1/2˝ npt connection) through a strainer and a pressure reducing valve.

The equalization (vent) connection on top of the pump tank should be connected to the receiver. The equalization line should not be reduced in size and be installed with minimal restrictions. If the equalization line is more than 36" in length, the pipe size should be increased at least three pipe sizes. In cases where a combustible liquid is being handled or the motive used is combustible, the vent must go to a flare or flame.

For LROO and LOOO models, friction loss through the piping should be kept to a minimum. Therefore, pipe reducers should not be used and pipe runs kept to a minimum. All hand valves should be full port if at all possible. It is recommended that isolation hand valves be installed to aid in the maintenance of the units. Some suggested locations are: upstream of the inlet check valve, downstream of the outlet check valve, in the motive line ahead of the strainer, in the equalization line between the float assembly and the receiver, and ahead of the pressure reducing valve.

Pressure Reducing Valve Installation

A pressure reducing valve (PRV) should be installed in the motive pressure line to regulate how fast the Liqui-Mover pump discharges the condensate out of the pump tank. Normally the motive pressure setting will be approximately 20 psig higher than the back pressure to achieve a proper discharge time. The discharge time should be a little less than the time it takes to fill the pump tank under maximum condensing load.

Here are some guidelines to be followed when installing a PRV in conjunction with a Liqui-Mover pump:

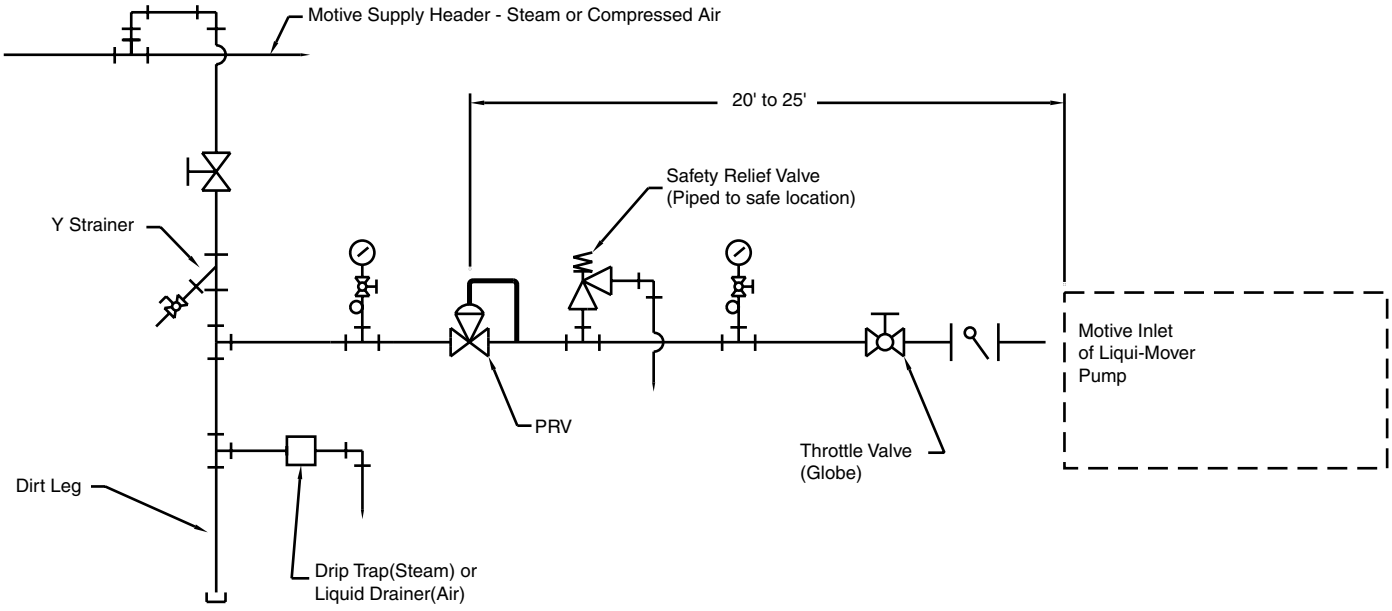
1. Never install a PRV immediately adjacent to the Liqui-Mover pump. The shock caused by the sudden opening and closing of the motive valve will ultimately damage the PRV. We recommend a distance of 20-25 feet between the PRV and the Liqui-Mover pump, where the pipe size is the same as the motive inlet connection. A larger diameter pipe of a shorter length that has an equivalent volume is acceptable. The PRV should be sized by a pressure reducing valve manufacturer or representative.

2. A safety relief valve should be installed downstream of the PRV to prevent over-pressurization of the motive medium. The safety relief valve should be sized by a safety relief valve manufacturer or representative.

3. When steam is the motive pressure, a drip trap, dirt leg, and strainer should be installed ahead of the PRV. The drip trap should not be piped to the Liqui-Mover pump. When compressed air is the motive pressure, a liquid drainer, dirt leg, and strainer should be installed ahead of the PRV. The liquid drainer should not be piped to the Liqui-Mover pump.

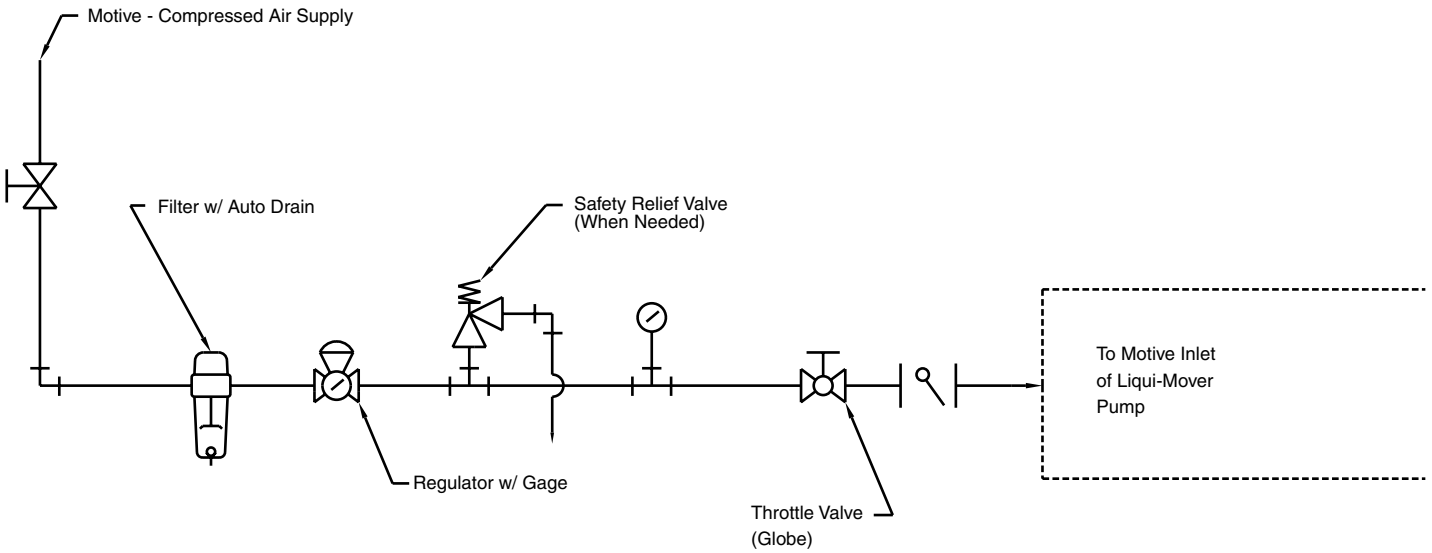
4. The piping from the PRV outlet to the Liqui-Mover pump should be sized to minimize the pressure drop under ‘flow conditions’.

5. A throttling valve should be installed immediately ahead of the Liqui-Mover pump so it can be used in conjunction with the PRV to adjust the Liqui-Mover pump discharge time. Typically the throttling valve is a globe valve.



The above sketch is for reference only. Always consult with the PRV and safety relief valve manufacturer or representative for proper sizing and application of their products.

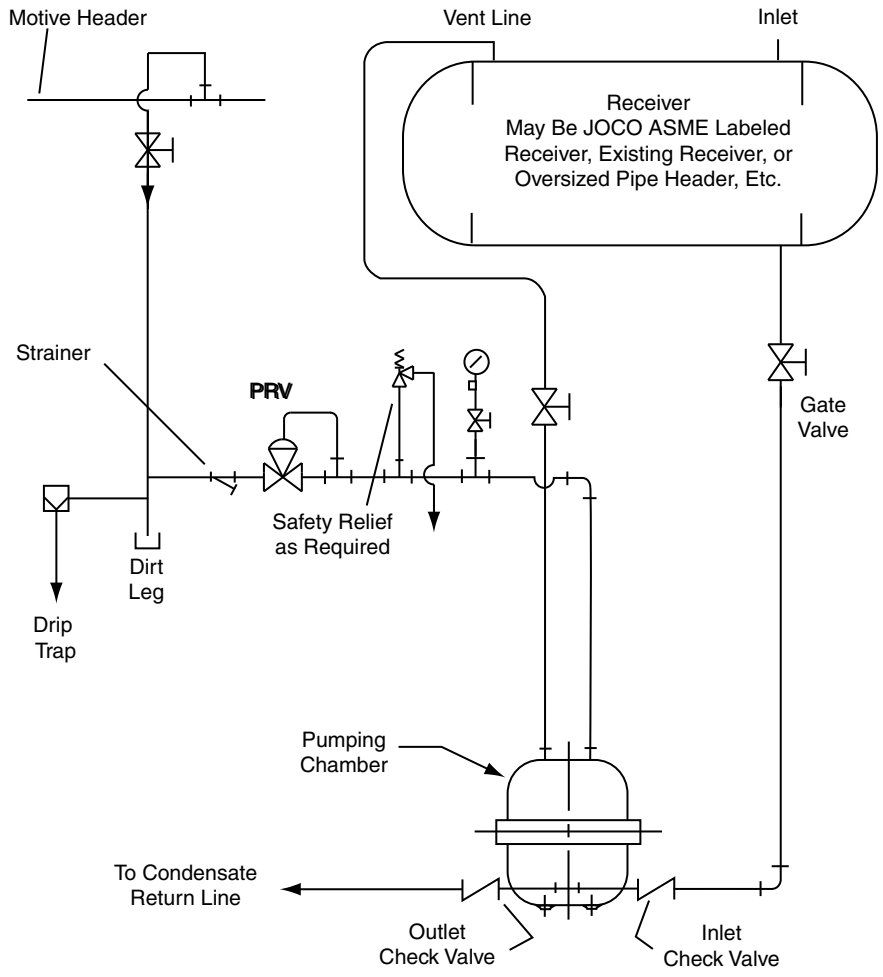
Installation Diagram for Liqui-Mover Pump with Compressed Motive



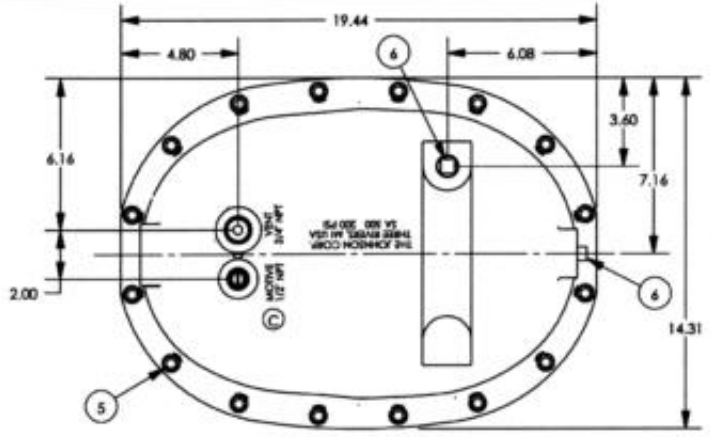
1. This is the recommended piping for a Liqui-Mover pump with compressed motive.
2. The air should be clean, dry and regulated so that the Liqui-Mover pump discharges in the recommended time.
3. The above parts furnished by customer.

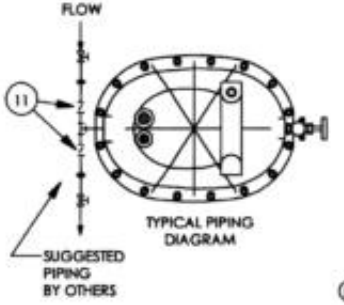
Start-Up Instructions For LMHT-500 Liqui-Mover Pump

1. On systems that are not pre-piped, inspect the inlet and outlet check valves for proper flow direction. Refer to the Liqui-Mover pump assembly drawing and parts list.
2. If the receiver or pump chamber contains sub-cooled condensate, this needs to be drained prior to start-up.
3. Open any additional maintenance hand valves that were installed for maintenance.
4. Open any hand valves in the discharge line. Open the vent line hand valve. Open the hand valves that supply condensate to the pumping chamber.
5. To set the discharge cycle time, a PRV is recommended and should be set for approximately 20 psig above the back pressure. If a globe valve is used in conjunction with a PRV, the globe valve should be fully open. If a PRV is not used, the globe valve should be opened slightly. After the system is operating this valve should be adjusted so the pump time is slightly less than the fill time.
6. When the pumping chamber is full, the level control will automatically close the vent valve and open the high pressure motive valve, allowing motive to enter the pumping chamber and condensate to flow out the discharge line.
7. When the pumping chamber is empty, the level control will automatically close the motive valve and open the vent valve, allowing the pumping chamber to vent into the receiver, equalize pressure, and begin filling.



TYPICAL INSTALLATION SKETCH



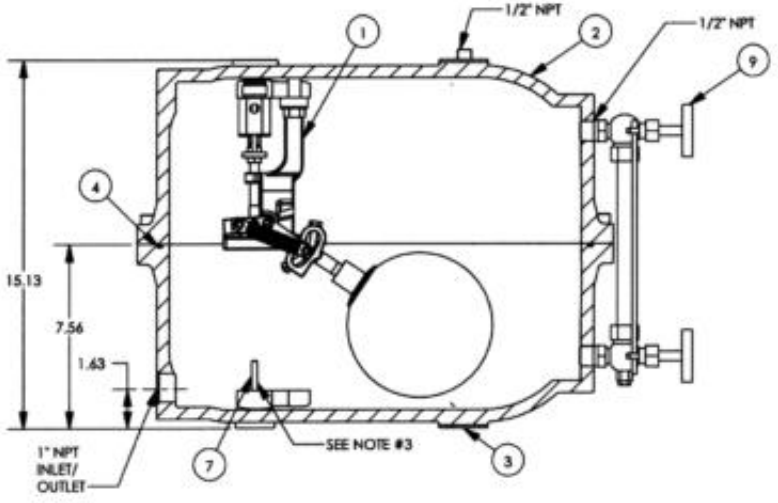


PARTS LIST

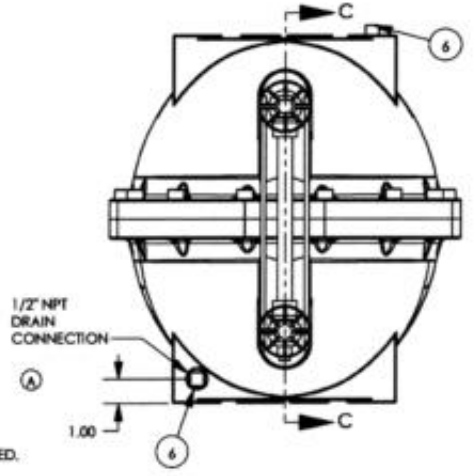
ITEM NO.	NO. REQ'D	PART DESCRIPTION	PART NUMBER	MATERIAL	REMARKS
1	1	LEVEL MECHANISM	SA3V-500-1	STN. STL & D.I.	
2	1	TANK TOP	SA500-1	C.I.	
3	1	TANK BOTTOM	SA500-2	C.I.	
4	1	O-RING	CS5825-281-E	EPR	
5	16	SOCKET HEAD CAP SCREW	7/16-14 x 1.5" LG.	STL. SA574	
6	4	1/2" NPT PIPE PLUG	CSP660-0050-30-01	M.I. 300#	
7	2	GROOVE PIN	CSF229-0250-162-01	STEEL	

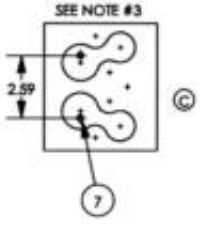
OPTIONAL EQUIPMENT PER ORDER

ITEM NO.	NO. REQ'D	PART DESCRIPTION	PART NUMBER	MATERIAL	PIPE SIZE	PIPE DESIG. XX
9	1	LEVEL GAUGE ASSEMBLY	LMH-A-00803-1	BRASS & GLASS		
10	1	PRESSURE GAUGE ASSEMBLY	LMH-A-06565-1	METAL & PLASTIC		
10	1	CYCLE COUNTER ASSEMBLY	V-11063-10	METAL & PLASTIC		
11	1	SILENT CHECK VALVE ASSY.	LMV-A-CKV-1	STN. STL. & STEEL	1/2"	50
11	1	SILENT CHECK VALVE ASSY.	LMV-A-CKV-2	STN. STL. & STEEL	3/4"	75
11	1	SILENT CHECK VALVE ASSY.	LMV-A-CKV-3	STN. STL. & STEEL	1	10
11	1	SWING CHECK VALVE ASSY.	LMV-A-CKV-4	BRASS & STEEL	1	10



SECTION C-C
SCALE 1 : 5





IF CHECK VALVES ARE TO BE SUPPLIED BY JOCO - REPLACE THE "XX" IN SYMBOL NUMBER BELOW WITH THE PIPE SIZE DESIGNATION FROM THE TABLE ABOVE.
IF CHECK VALVES ARE TO BE SUPPLIED BY OTHERS - REPLACE THE "XX" IN SYMBOL NUMBER BELOW WITH "00".

ALL UNITS IN INCHES UNLESS SPECIFIED.

4. .44 CUBIC FOOT OF CONDENSATE PER CYCLE - NOMINAL
3. USE THESE TWO PINS AS A GUIDE FOR SPRING END ALIGNMENT
2. MAXIMUM MOTIVE DIFFERENTIAL PRESSURE IS 90 PSIG
1. MAXIMUM DESIGN PRESSURE IS 200 PSIG

NOTES:

ALL DIMENSIONS +/- [.12] 3MM UNLESS SPECIFIED

Permissible deviations on untoleranced machining dimensions as below

ISO 2768-m

Dimensions in		Tolerance in	
mm	[inch]	± mm	±[inch]
Up to 6	0.24	0.1	0.004
6-30	0.24-1.18	0.2	0.008
30-120	1.18-4.72	0.3	0.01
120-400	4.72-15.75	0.5	0.02
400-1000	15.75-39.37	0.8	0.03
1000-2000	39.37-78.75	1.2	0.05
2000-4000	78.75-157.5	2	0.08

PATTERN NO:

REFERENCE DRAWING: RDB5451

ANGULAR TOLERANCE: ±0°30'

LOCATION: 111

REQUEST NO: 1296-43

DEBURR:

DRAWN BY: HCT

CHECKED BY: SAB

DATE: 1/20/1997

PROJECTION:

TREATMENT:

MATERIAL: SEE PARTS LIST :JOCO/CAN
:JOHO
:JOCHI
:JOLA

TITLE: LMSA - HORIZONTAL TANK ASSEMBLY AND PARTS LIST

PP

SYMBOL NO: LMHT-5XX-LOOO-FSA-01

JOHNSON
www.joco.com

SCALE:	PAGE:	DRAWING NO:	REV:
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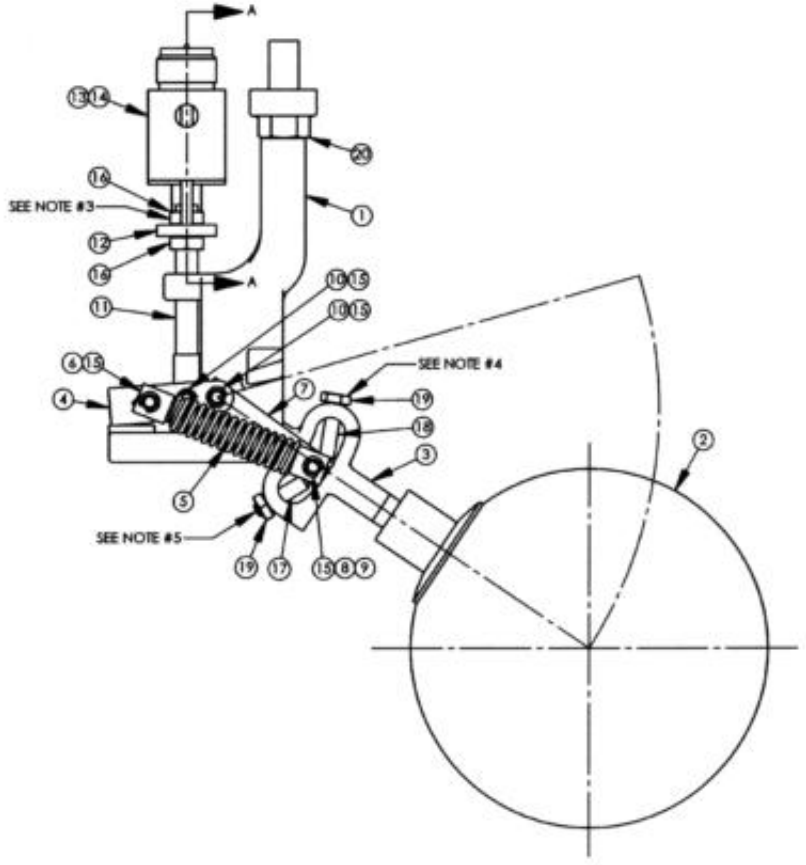
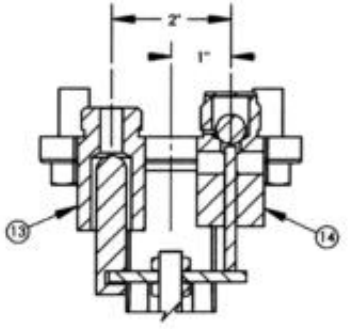
V1.0



PARTS LIST

	ITEM NO.	NO. REQ'D	DESCRIPTION	PART NO.	MATERIAL	REMARKS
Ⓓ	1	1	SUPPORT FRAME	SA501-1	DUCTILE IRON	PLATED
	2	1	FLOAT	SA1003	STAINLESS STEEL	
	2	1	FLOAT ARM	SA504-1	STAINLESS STEEL	
	4	1	LINKAGE YOKE	SA1005-1	STAINLESS STEEL	
	5	2	SPRING	SA1007-2	STAINLESS STEEL	
	6	4	SPRING END	SA1009-1	STAINLESS STEEL	
	7	2	FOLLOWER LINK	SA1010	STAINLESS STEEL	
	8	2	RETAINING RING	CSF230-0031-02	STAINLESS STEEL	
	9	1	FOLLOWER ROD	SA1012	STAINLESS STEEL	
	10	2	PIVOT PIN	SA1013	STAINLESS STEEL	
	11	1	ACTUATING ROD	SA515	STAINLESS STEEL	
Ⓓ	12	1	WASHER	SA517	STAINLESS STEEL	
	13	1	VENT VALVE ASSY.	SA533	STAINLESS STEEL	
	14	1	INLET VALVE ASSY.	SA532	STAINLESS STEEL	
	15	8	RETAINING RING	CSF230-0018-02	STAINLESS STEEL	
	16	2	JAM NUT	3/8-24	STAINLESS STEEL	
	17	1	SOCKET HEAD SET SCREW	1/4-20 X 1" LG.	STAINLESS STEEL	
	18	1	SOCKET HEAD SET SCREW	1/4-20 X 1-1/8" LG.	STAINLESS STEEL	
	19	2	JAM NUT	1/4-20	STAINLESS STEEL	
	20	2	HEX HEAD CAP SCREW	1/2-13 X 1" LG.	STEEL SA325-1	



Ⓒ SECTION A-A

Ⓐ 6. MAKE SURE THE SIDE OF THE LINKAGE YOKE WITH THE CAST PART NUMBER IS AWAY FROM THE SUPPORT FRAME MOUNTING SURFACE.
Ⓑ 5. WITH THE SET SCREW (18) ADJUSTED AND TOUCHING THE FOLLOWER ROD (9) ADJUST THE SET SCREW (17) SO THAT IT TOUCHES THE FOLLOWER ROD (9) AND THEN BACK IT OFF 1/2 TURN AND JAM THE JAM NUT (19).
4. ADJUST THE SET SCREW (18) FLUSH WITH THE JAM NUT (19).
3. SET CLEARANCE BETWEEN THE WASHER (12) AND THE STEAM VALVE (14) TO .120" WITH AIR PRESSURE ON THE MOTIVE CONNECTION.
2. USE LOCKTITE 272 ON ALL THREADS.
1. USE TEFLON TAPE ABOVE THE THREADS AND OVER THE SEALING SURFACE OF BOTH VALVES.

NOTES:

ALL REVISIONS SHALL BE MADE IN SOLIDWORKS

SA3V-500-1

ASSEMBLY & PARTS LIST
OF LEVEL MECHANISM
FOR HORIZONTAL TANK LMSA

3/8" ORIFICE

The Johnson Corporation
Three Rivers, Michigan / Summerstown, Ontario

DATE	DWN.	DR#	SYMBOL NO.	REV	DWG. NO.
1/20/1996	HCT	1296-43	SA3V-500-1	D	B2860
SCALE 1/2	CHK. SAB	CHK.			

LIQUI-MOVER® PUMP
REPAIR KITS

RK-LMSA Motive and Vent Valves

ITEM	QTY	PART NAME	PART NUMBER	MATERIAL	REMARKS
12	1	Washer	SA517	Stn. Stl.	
13	1	Vent Valve Assembly	SA533	Stn. Stl.	
14	1	Inlet Valve Assembly	SA532	Stn. Stl.	

RK-SA3V-500 Repair Kit

ITEM	QTY	PART NAME	PART NUMBER	MATERIAL	REMARKS
4	1	Linkage Yoke	SA1005-1	Stn. Stl.	–
5	2	Spring	SA1007-2	Stn. Stl.	–
6	4	Spring End	SA1009-1	Stn. Stl.	–
7	2	Follower Link	SA1010	Stn. Stl.	–
8	2	Snap E Ring	CSF230-0031-02	Stn. Stl.	–
9	1	Follower Rod	SA1012	Stn. Stl.	–
10	2	Pivot Pin	SA1013	Stn. Stl.	–
11	1	Actuating Rod	SA515	Stn. Stl.	–
12	1	Washer	SA517	Stn. Stl.	–
13	1	Vent Valve Assembly	SA533	Stn. Stl.	–
14	1	Inlet Valve Assembly	SA532	Stn. Stl.	–
	1	O-Ring	CSS825-281-E	EPR	–
15	8	Retaining Ring	CSF230-0018-02	Stn. Stl.	–

GENERAL TROUBLESHOOTING OF FLOAT ACTUATED LIQUI-MOVER® PUMPS

OBSERVATION		PROBABLE CAUSE	REMEDY
1. Liqui-Mover pump fails to fill.	1. Increase in liquid level in receiver, possible flood in receiver.	Obstruction in fill line, valve closed, inlet check backwards.	Inspect fill line for closed valve, inlet check in reverse, or obstruction in fill line. Refer to Assembly & Parts List Drawing.
	2. Receiver empty, Liqui-Mover pump level fluctuating.	Receiver pressure greater than pressure in discharge line.	If unit has been in operation for a period of time without problems, check for traps blowing through. If new installation, receiver pressure may be greater than anticipated. Back pressure may be less than anticipated. A 2-Way control valve may be required in discharge line.
2. Liqui-Mover pump fills too slow.	1. No liquid level in receiver.	Load to unit not as great as anticipated.	No action required.
	2. Receiver flooding.	Obstruction or restriction in fill line.	Inspect fill line for partially closed valve or defective check valve. Inspect fill line for proper size fittings and pipe. Refer to Assembly and Parts List Drawing for specific unit.
	3. Receiver flooding.	Restriction in vent line, motive and vent valve assembly out of adjustment.	Inspect vent line for partially closed valve, proper size fittings and pipe. Refer to Assembly and Parts List Drawing.

OBSERVATION		PROBABLE CAUSE	REMEDY
3. Liqui-Mover pump fills very rapidly.	1. Unit cycling almost normally, receiver flooding.	Defective check valve in discharge line and/or fill line. Possible back flow to Liqui-Mover pump.	Inspect discharge line check valve and fill line check valve. Refer to Assembly and Parts List Drawing.
4. Noise in or at fill line check valve.	1. Vibration and water hammer at fill line check valve.	Cold condensate.	Inspect for cold condensate. Throttle flow control valve, ahead of Liqui-Mover Pump assembly. Refer to Assembly and Parts List Drawing, and start-up procedure.
5. Liqui-Mover pump discharges very rapidly.	1. Water hammer in discharge line.	Motive pressure too high.	Throttle flow control valve or install pressure reducing valve. See start-up procedure.
	2. Receiver flooding, rise in receiver pressure during discharge.	Defective check valve in fill line. Discharging condensate back into receiver.	Inspect fill line check valve. Refer to Assembly and Parts List Drawing.
6. Liqui-Mover pump discharge cycle too long.	1. Possible receiver flooding.	Flow control valve throttled too much.	No action required, if receiver not flooding. If receiver flooding, adjust flow control valve for discharge of 10 - 15 seconds (approx.).
	2. Receiver flooding.	Restriction or increase of back pressure in discharge line.	Inspect discharge line for partially closed valve(s), obstructions or change in pressure. A pressure increase may require adjustment of flow control valve to reduce discharge time. Inspect discharge check valve.

OBSERVATION	PROBABLE CAUSE	REMEDY
3. No motive pressure flow. Receiver flooding.	Motive supply failure, obstruction in motive supply line.	Inspect for motive supply pressure, closed valve, or obstruction in motive supply line. Inspect strainer.
4. Inlet Valve noisy.	Condensate in motive supply line.	Inspect motive supply line for condensate. Check drip trap. Refer to Assembly and Parts List Drawing.
5. Receiver pressure increase during discharge.	Valve assembly out of adjustment. Motive pressure leakage into receiver, defective Fill Check Valve.	Refer to Float Mechanism Assembly Drawing.

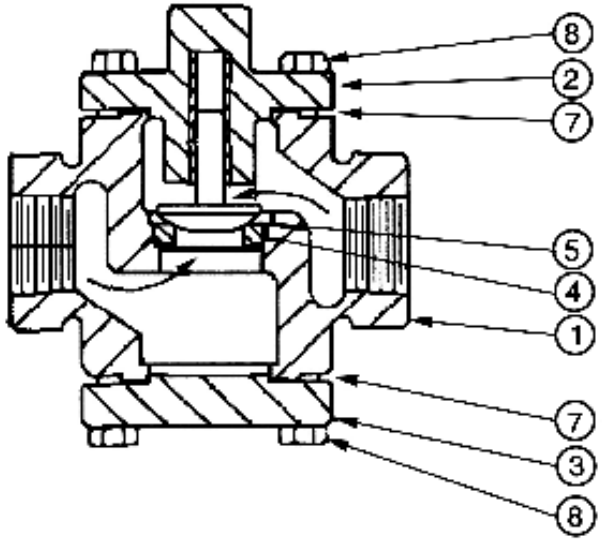
Repair Instructions For
Johnson Lift Style Check Valves

REBUILDING

1. Isolate unit, disconnect electricity and close hand valves.
2. Remove Check Valve from piping being cautious of hot liquids.
3. Remove top (2) and bottom (3) caps.
4. Press out old seat (4). Being careful not to mar seating surfaces.
5. Discard old plug (5) and seat (4).
6. Clean the seating surfaces in the body (1) as well as gasket surfaces on the body and caps using a wire brush or scraper – **Do not remachine.**
7. Apply a layer of Permatex to seating surface.
8. Press new seat into body (1) with the sharp edge of I.D. facing up.
9. Once the seat is pressed in, inspect to make sure it is seated firmly in the body and a ring of Permatex has been pressed out around the bottom of the valve seat.
10. Clean off excess Permatex.
11. Apply Lapping Compound to the sealing face of the new plug (5) and lap to the seat for a minimum of five minutes.
12. Remove Lapping Compound and inspect plug (5) for continuous lapped ring mark around the sealing face.
13. If sealing face of plug looks well lapped, then place it on the seat (4) in the body (1).
14. Make sure bushing in top cap (2) is clean.
15. Place top cap (2) with gasket (7) over end of plug (5) and on top of body (1).
16. Attach with cap screws (8) applied with Never Seize and tightening evenly.
17. See Testing Procedure if testing is desired.
18. Attach bottom cap (3) and gasket (7) to bottom of body the same as Step 16.
19. Reconnect to piping.
20. Connect electricity and open hand valves.

TESTING

1. With bottom cap (3) off, connect outlet side of Check Valve to cold water service line (approximately 50 psi).
2. Lift plug (5) with hand and open water line.
3. When water begins to flow through the valve, allow plug (5) to drop to the seat (4) and wait one minute.
4. If valve seals, drips a few drops with no extreme leakage, water spray or continuous water flow, then valve is OK.
5. In case of extreme leakage the top cap (2) can be loosened slightly and shifted around on the body (1). If unsuccessful, the seat may need to be relapped.



Note: • Exert caution when working with Liqui-Mover pumps as unit may be hot.

- (#) = Item No. per Figure 1.
- Permatex Part No. 1 C Fast Drying Hard Setting
- Lapping Compound: Clover-Silicone Carbide Grease Mix 800 Grit Part No. 5A 51803, Grade 5A

LMHT-SA
PREVENTATIVE MAINTENANCE
CHECK LIST

HOW OFTEN	CHECK	REFERENCE
1 Year	1. Check anode in receiver tank (if applicable).	Drain tank – remove anode by unscrewing anode plug on the receiver tank end. If over 60% eaten away, replace.
	2. Clean gauge glass when required.	Disassemble and pull clean cloth through glass with cleaning wire.
	3. Drain tank and flush to remove residue.	Remove drain plug in the bottom of tank and flush. Replace plug afterwards.
	4. Pull internal mechanism and inspect for wear on pins and linkage and for buildup on the float.	Remove cap screws in top flange and remove internal mechanism and inspect.

CAUTION: Before performing any of the above maintenance checks, shut off all steam and condensate lines connected to the unit.